BUSINESS TRANSFORMATION AGENCY

Enterprise Architecture based on Design Primitives and Patterns

Guidelines for the Design of the Integrated Dictionary (DoDAF AV-2)

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Version History

Version	Publication Date	Author	Description of Change
0.1	2009-01-28	James Kindrick	Initial Draft
0.2	2009-02-02	James Kindrick	Pre-Publication Draft
1.0	2009-02-03	James Kindrick	Initial Version for DoDAF Journal

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Acronym List

Acronym	Definition
AV-2	All View 2: Integrated Dictionary
BTA	Business Transformation Agency
COI	Community Of Interest
DARS	Department of Defense Architecture Registry System
DoD	Department of Defense
DoDAF	Department of Defense Architecture Framework
DM2	DoDAF Meta Model
DMM	DoD Metadata Registry
EA	Enterprise Architecture

Executive Summary

Enterprise Architecture (EA) is a key enabler of enterprise business process integration. While Architecture Frameworks such as DoDAF exist to guide the development of consistent architecture artifacts, significant roadblocks still exist for effective architecture development, adoption, integration, and federation.

Many of these roadblocks result from the lack of uniform representation and consistent terminology for the same semantic content. Architects use different methodologies to develop models; these models are represented using different modeling languages and created using different modeling tools. Enterprise architecture is necessarily created by different organizations or parts of an organization and across multiple disciplines that employ different terminologies leading to different perceived business processes.

There is a need for standard terminology for the concepts and data that moves within the enterprise that the various architecture models and views represent. Without it there is difficulty in developing, understanding and using enterprise architectures. Without a common vocabulary, there is:

- No interoperability between architecture / modeling systems – a roadblock for architecture development.
- Poor communication between modelers and decision makers – a roadblock for architecture adoption.
- Unclear relationships between different architecture views – a roadblock for architecture integration.
- Ineffective understanding across different architectures – a roadblock for architecture federation.

Our proposed solution is a baseline for *Vocabulary-Driven Architecture Development*, providing a process for AV-2 development of controlled vocabulary for architecture products. This report provides guidance on construction of the AV-2 Integrated Dictionary leading to a common vocabulary for enterprise architecture development.

1 Background

1.1 What is the AV-2 Integrated Dictionary?

The AV-2 architecture product (Integrated Dictionary) defines the terms used in DoDAF architecture products. Its purpose is to serve as a common vocabulary and terminology reference for architecture products and other architectures and to provide unambiguous architecture concepts for architecture model developers and users.

1.2 The Current State of AV-2 Construction

The current practice of developing AV-2 products has several weaknesses:

- The AV-2 is typically a derived product that does not lead development efforts. To date, AV-2 products are commonly derived from existing architecture products and typically generated 'after the fact', i.e. after other architecture products are completed. However, a generation of architecture products from an AV-2 is typically not possible, i.e., while an AV-2 can be derived from an OV-7 (data model), it is significantly more difficult to generate an OV-7 from an existing AV-2.
- The AV-2 is typically a simple table structure that neglects data management capabilities provided by other representations, such as the cross-referencing of terms, extensions of pre-populated AV-2s, and/or the reuse of common definitions. The static structure of the AV-2 and the lack of underlying semantic annotations mean that a user cannot browse or reason about relationships among terms, which increases the risk that the AV-2 is not a living document and becomes obsolete while other aspects of the architecture description evolve. In addition, there is little guidance for conflict resolution of terminology conflicts. Two particular types of conflicts are prevalent in architectural development: Homonyms, i.e. one term with multiple, context-dependent definitions (e.g. tank in the context of an architecture for infantry communication systems viz. tank in the context of an airplane architecture), and Synonyms, i.e. multiple terms that share the same definition (e.g. target and effect object). The absence of a consistent method for conflict resolution bears the risk that these conflicts go unnoticed and create ambiguities and inaccuracies in the resulting architecture.
- The relationship between AV-2 contents and other architecture products is not explicit. The relationship of terms in an AV-2 to the concepts of the underlying DoDAF meta model (CADM in DoDAF 1.5) is currently implicit. This implies that an architect cannot check the completeness of architecture products against a list of mandatory concepts set by architecture users in an AV-2. Furthermore, it is not possible to analyze the coverage of the architecture products against the concepts of the DoDAF meta model, which would aid the discovery of linkages between architecture products or the lack thereof.

2 Why Vocabulary-Driven Architecture Development?

The current state of AV-2 design suggests a number of changes leading towards a vocabulary-driven approach to development of Enterprise Architectures where:

- AV-2 definition leads the architecture development effort, providing a clear common vocabulary for architects to use as they develop the architecture.
- AV-2 terms and relationships are stored in a repository with data management capabilities that allow for reasoning over the terms of the architecture and to define relationships among terms and data persistency for future reference and reuse of the common vocabulary terms and definitions.

- The AV-2 provides a validation instrument for the architecture based on explicit relationships between the AV-2 contents and other DoDAF architecture products. AV-2 terms should map to elements of the DoDAF meta model (DM2) in order to support coverage and completeness analysis. This mapping makes the relationship of AV-2 terms to the different DoDAF models explicit, i.e. it is useful to locate models that contain a particular term.

2.1 AV-2 Construction Drives Integrated Architectures

An initial version of the AV-2 should be developed at the beginning of any architecture product, to gain clarity over objectives and constraints of the architecture and to define and disambiguate key terms of the architecture, with conflict resolution of homonyms and synonyms. This initial AV-2 provides a baseline to be refined and expanded in an iterative fashion throughout the architecture development process. The result is a controlled vocabulary for all the architecture products that is harmonized across all views and models of the enterprise.

2.1.1 General AV-2 Development Process

The generic process for the development of an AV-2 consists of seven steps. The process is consistent with the one described in the "DoDAF Architecture Development Process for the Models" Microsoft Project Plan, and should be initiated after the initial outline of the architecture has been developed, i.e. AV-1 and OV-1 exist. An AV-2 consists of defined terms and derived terms. Defined terms are those specified at the outset of an architecture project, while derived terms emerge during the development of subsequent architecture products. The purpose of this process is to ensure a sufficient set of defined terms at the beginning of an architecture project, and to allow for subsequent expansion and extension of this initial set of terms. It is an iterative process that accompanies the development of other architecture products.

1. **Generate Terms and Definitions**
   During this step the key terms are gathered from domain subject matter experts (SMEs) and a set of definitions is created. At the very start of the architecture development effort, these terms and definitions are typically derived from the AV-1 and related documents, and includes the definition of mandatory architecture components required by project sponsors and architecture users. As development of the architecture progresses, additional terms and definitions are identified and documented during the creation of other architecture models and products and this process repeats until the required completeness, coverage, and level of detail is achieved.

2. **Import Terms and Definitions into AV-2 Template**
   Development of the AV-2 is currently supported by a simple template allowing the architect to relate each term and definition to a DoDAF meta model (DM2) concept. The AV-2 should initially be focused on what the target architecture should be capable of achieving, not how this functionality should be rendered.

3. **Map Terms to DoDAF 2.0 Concepts**
   During this step the existing terms are mapped against the DM2 concepts. The starting point should be the key elements of the DM2: Capabilities, Resources, Activities, and Performers. Note the DM2 contains many additional elements which will be defined and refined in later development cycles.

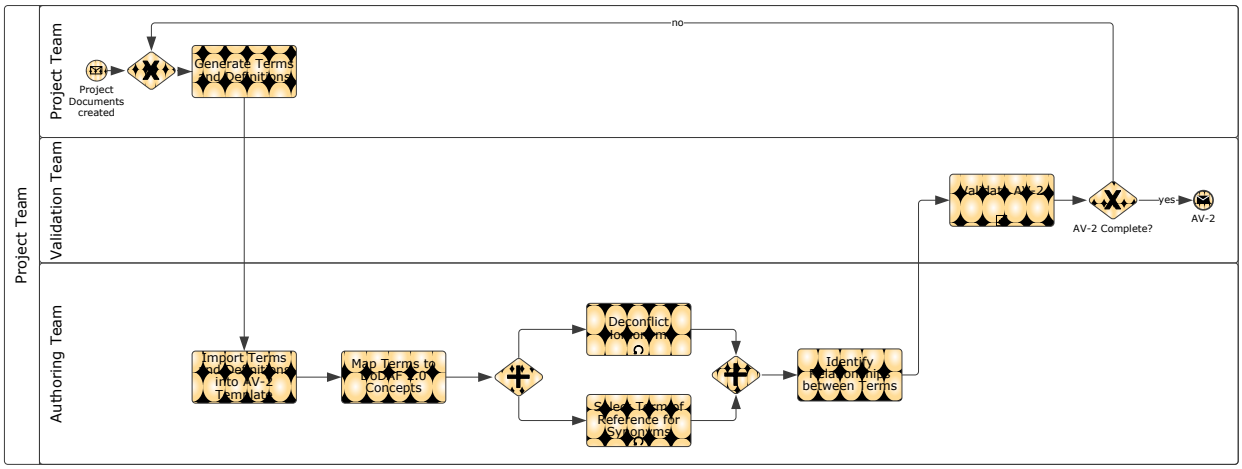
4. **Deconflict Homonyms**
   In order to disambiguate term homonyms the architect should either change one of the homonym terms, or add a suffix that specifies the context of the related definition (e.g. tank[army] vs. tank[air force])

5. **Set Term of Reference for Synonyms**
   In case of multiple terms that relate to the same definition the architect should determine one term of reference. Additional terms can be explicitly listed as synonyms, but should not be listed as terms in their own right.

6. **Define Relationships between Terms**
Dependencies between terms (such as generalization/specialization and whole/part relationships) should be documented in this step.

7. **Evaluate AV-2 Completeness and Coverage**
The final step of the development process tests the AV-2 for coverage of the DoDAF meta model and completeness against project requirements. If the AV-2 is found to be incomplete a new round of revisions is initiated, otherwise the result of the process is the finished AV-2.

Figure 2-1: General AV-2 Development Process



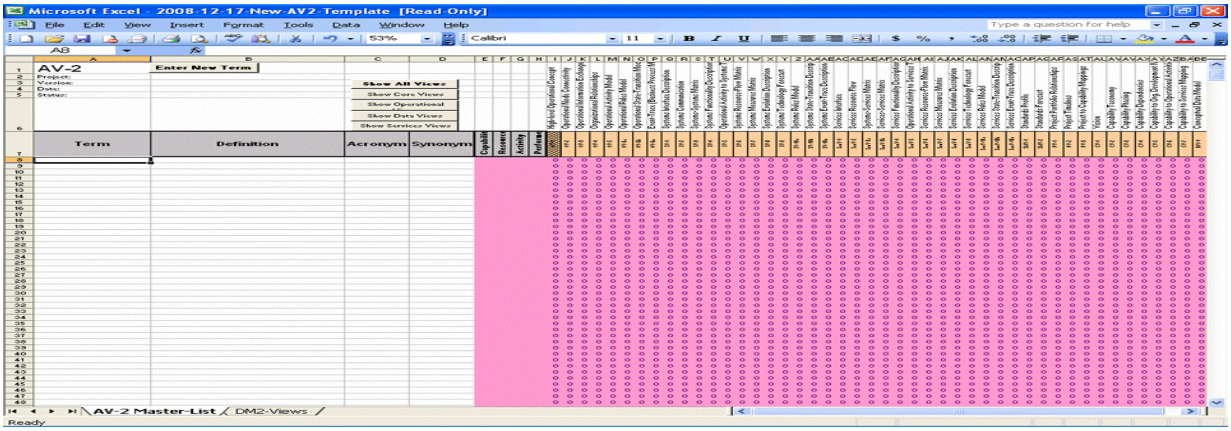
2.2 AV-2 Repository Links Architecture to the DoDAF Meta Model

Individual AV-2s should be stored in a central repository for future reference and reuse. Entries in the AV-2 are organized in this repository according to data types of the DODAF 2 meta model (DM2). Tables/Spreadsheets can be effectively used as a data-capture mechanism, but there needs to be a defined transfer process to port this data into a persistent repository structure underpinned by the coherent meta model of the DM2. This repository allows the architect to import the semantics of various models from different parts of the organization and to integrate these views across the enterprise.

2.2.1 Template for AV-2 Development

In order to support the development of AV-2 products an Excel template is provided, as illustrated in Figure 2-2. This template can be used for data capture. Given the DoDAF mapping of meta model concepts to architecture models that contain them, the template can help identify the set of architecture models within which the defined term is relevant. By mapping the terms in an AV-2 to the concepts of the underlying DoDAF meta model it is possible to trace the relationship between a term and the different architecture models in which this term occurs. In future this template should be replaced by a web-based form that is linked to a database for easier storage, manipulation and rendering of AV-2 content.

Figure 2-2: Example AV-2 Development Template



3 AV-2 Construction in the 6-Step Development Process

DoDAF v2.0 (Volume 1, Section 7.1.1) provides a high-level, six-step architecture development process based on the DoDAF development guiding principles described in Volume 1 Section 3.5. The general process for AV-2 development fits neatly into this six-step architecture development process. The important concept for all steps of the architecture development process is the continual collection, recording, and reuse of a consistent, harmonized and integrated common vocabulary.

3.1 Initial Steps: Intent and Scope

Steps 1 and 2 of the six-step process are the beginning activities for architecture development and characterize the intended use, purpose, and scope of the architecture effort. This information is generally provided by the architecture owner describing some aspect of their area of responsibility (process, activity, etc.) undergoing review, and is intended to insure the resulting architecture is "Fit for Purpose".

3.1.1 Start at the Beginning

Collection of glossary terms and definitions begins at Step 1 and should continue throughout the architecture development process. Vocabulary terms and definitions are identified, disambiguated, harmonized and recorded in a consistent format using the suggested AV-2 data dictionary template and Common Vocabulary process. As architecture data is identified to help clarify the appropriate scope of the architecture effort, vocabulary terms and definitions should be disambiguated, harmonized and recorded in a consistent format. Analysis of common vocabulary across different architectures with similar scope will help to clarify and determine appropriate architecture scope, and ultimately support the goal of architecture federation.

3.2 Core Steps: Define and Document

Steps 3 and 4 of the six-step process are the core activities in developing the architecture models and views, and thus produce the bulk of the terms and definitions required for the AV-2. The initial type of architecture data content to be collected is determined by the established scope of the architecture, and recorded as concepts, attribute and associations as described in the DoDAF meta model (DM2). This can often be simplified through reuse of data previously collected by others that is relevant to the current effort. Access to appropriate COI data and other architecture information, discoverable via DARS and the DoD Metadata Registry (DMM) can provide information on data and other architecture artifacts and products that may prove useful in a current effort.

Since DoDAF prescribes a mapping from DM2 elements to architecture models, a set of identified DM2 elements suggests the architecture models relevant to these concepts that the architect may develop using associated architecture methods during the more comprehensive and coherent data collection of Step 4. While Step 3 is a 'top-down' conceptual approach to data targeting and identification, the subsequent Step 4 is a practical 'bottom-up' approach for data capture usually based on architecture methods and model development. Architecture development typically iterates over these two steps. Terms and definitions recorded in the AV-2 template are

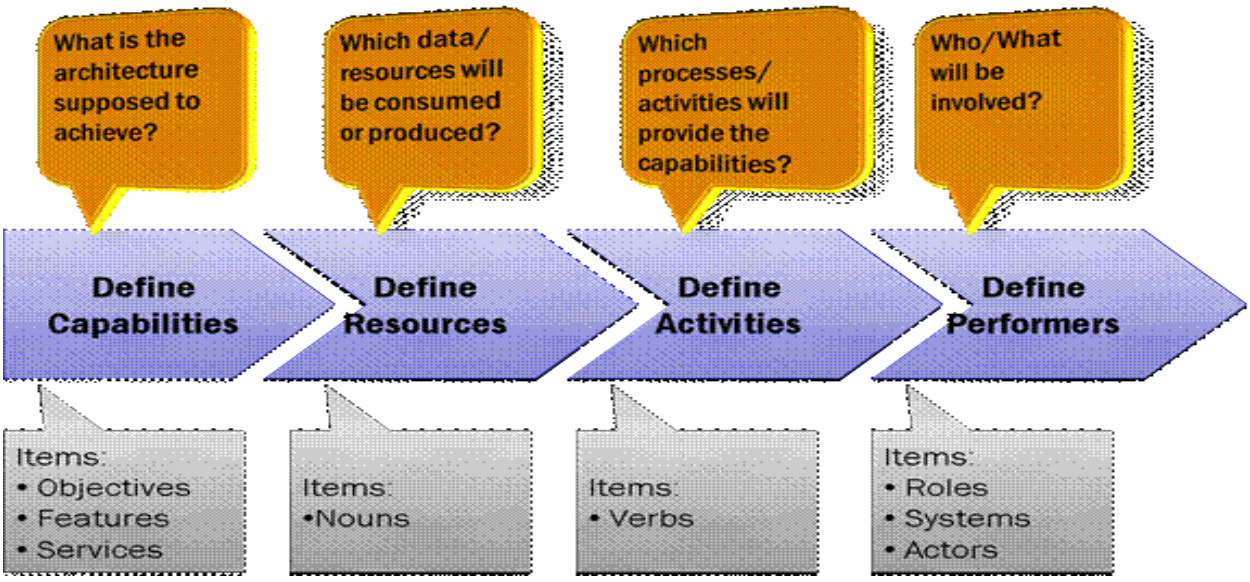
related to elements of the DM2. In turn, architecture models associated with these DM2 elements suggest additional data content to be collected and recorded.

3.2.1 Central Points in the DM2

Architects typically collect and organize data through the use of architecture methods that produce architecture models, e.g. activity, process, organization and data models. As data is collected, vocabulary terms and definitions are correlated, harmonized and recorded in a consistent format using the AV-2 template. The starting points are central key elements of the DM2:

- Capability ("what"): The ability to achieve a desired effect under specified [performance] standards and conditions through combinations of ways and means [activities and resources] to perform a set of activities. Capabilities describe the desired functionality of an architecture and serve as a set of top-level objectives.
- Activity ("how"): Work, consisting of atomic or composite steps that transforms resources to achieve an objective/provide a capability. Activities describe the processes and procedures carried out to actively change an EffectObject, i.e. a target resource.
- Performer ("who"): Any entity - human, automated, or any aggregation of human and/or automated - that performs an activity and provides a capability.
- Resource ("with what"): Data, Information, Performers, Materiel, or Personnel Types that are produced or consumed.

Figure 3-1: Central Points in the DM2



Additional guidance for the AV-2 representation of these central DM2 elements is provided in Appendix A.

3.3 Review Steps: Validate and Iterate

Steps 5 and 6 of the six-step process test the architecture for completeness, accuracy, and sufficiency. Decision points related to including an architecture view, model, or even a term and definition are based on the intended use, purpose, and scope of the architecture effort determined in the first steps of development.

3.3.1 Appropriate Completeness and Coverage

Architectures that conform to DoDAF consist of multiple models, covering different aspects of the system that is being described. These models are not independent of each other as they share overlapping concepts. For instance, the inputs and outputs of an activity described in an OV-5 or an OV-6c are reflected in the data structures and classes of an OV-7. These overlapping concepts are reflected in DoDAF meta model concepts that occur in more than one architecture product. By mapping the terms in an AV-2 to the concepts of the underlying meta model it is possible to trace the relationship between a term and the different views in which this term occurs.

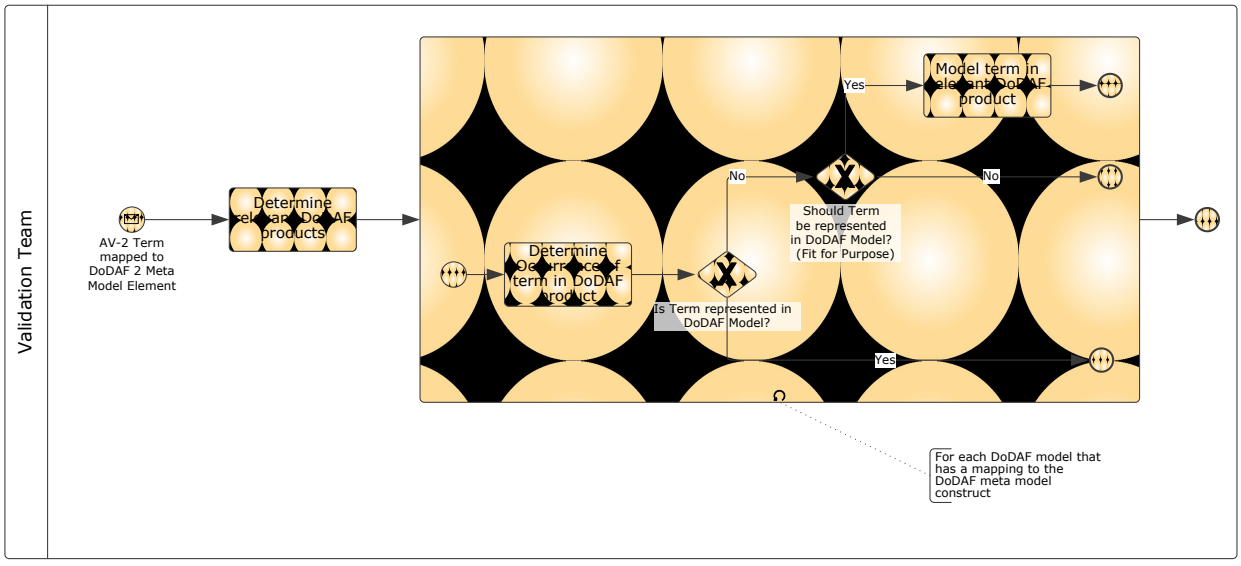
Table 3-1 Sample AV-2 Concept Relationships

AV-2 Term	DoDAF 2 Meta Model Concept	OV-6c Concept (BPMN)	OV-7 Concept (Class Diagram)	…
Intermediate C2	Performer	Lane	Class	…
Coordinate CAS Request	Activity	Task	N/A	…
…	…	…	…	…

Table 3-1 shows an example of such a trace. The term 'Intermediate C2' is a specific instance of the DoDAF meta model concept 'performer', which is depicted as a lane in BPMN (the representation recommended for OV-6c models) and as a class in UML Class Diagrams (the recommended representation for OV-7 models). The term 'Coordinate CAS Request' is an instance of the DoDAF meta model concept 'activity', which occurs in an OV-6c model, but not in an OV-7 model. In following a term to its DoDAF meta model concept a user can easily identify which models may contain references to this term.

In many cases the content of the AV-2 will emerge throughout an architecture design project. The first occurrence of an AV-2 term will thus be in a particular model that represents a view of the underlying architecture. Similar to the bottom-up validation approach it is possible to trace the model construct containing the term to the underlying DoDAF meta model, and determine from there which other model types should be populated with this term. Figure 3-2 shows this validation process formalized in BPMN.

Figure 3-2: AV-2 Validation Process



4 Appendix A: Central AV-2 Guidesheet

Step	Definition	Procedure/ Typical Questions	Linkage to other DODAF Products
1. Define Capabilities	Capabilities describe the desired functionality of a system and serve as a set of top-level objectives. A capability is the ability to achieve a desired effect under specified [performance] standards and conditions through the combination of ways and means [activities and resources] in order to perform a set of activities.	• Identify overall objectives of the system • What are the goals of the system? • What are the major design constraints? • What is the major functionality to be offered by the resulting system?	AV-1 Overview and Summary Information: The capabilities identified in this step should occur in the AV-1 architecture description document. Initial basis for CV-1, CV-2, CV-3, CV-4. Can be used later on to define CV-5, CV-6, CV-7.
2. Define Resources	Data, Information, Performers, Materiel, or Personnel Types that are produced or consumed by the resulting system.	• Identify the major objects and data elements (entities) of the system. • Identify the relationships among the resources (Structural Business Rules)	OV-7 (DIV-1): Data Model The results of this step become classes/tables in an eventual conceptual data model, which forms the basis for DIV-2 and DIV-3 products. OV-2/OV-3: Operational Resource Flow Diagram and Matrix
3. Define Activities	Work, consisting of atomic or composite steps, that transforms resources to achieve an objective. Activities describe the processes and procedures carried out to actively change an EffectObject, i.e., a target resource.	• Identify the major processes of the system that are needed to provide the desired capabilities. • Break the major processes into those activities necessary to achieve the objectives of each process. • Describe Activities in "Verb-Object" format (e.g.: write report). • Avoid unspecific verbs such as "manage" or "oversee" • Do not use "and" in activity labels: Break complex activities into individual steps	CV-6: Linkage between Activities and the Capabilities that they support OV-5: Activity Node Tree The results of this step become the activities in a hierarchical functional decomposition diagram OV-6c Business Process Model: The results of this step become the activities in an eventual process model Constraints among the activities can be used as the basis for OV-6a (Operational Business Rules)
4. Define Performers	Any entity - human, automated, or any aggregation of human and/or automated - that performs an activity and provides a capability.	• Revisit the list of resources identified in step 2 and identify those that actively contribute toward the completion of activities or the achievement of an objective	OV-4: Organizational Relationship Chart OV-6c Business Process Model: The result of this step defines the swimlanes in an eventual process model.